# PART 300
# EARTHWORK

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# SECTION 301

# GENERAL INFORMATION FOR EXCAVATION

## 301.1 STRIPPING

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer.

The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

Soil loosened below the stripping depth specified or designated by the Engineer, shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the Contractor at no additional cost to the City.

## 301.2 UNSUITABLE MATERIAL

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use shall be excavated and removed from the site or otherwise disposed of as directed by the Engineer.

## 301.3 SLOPES

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than six inches measured at right angles to the slope, except where excavation is in rock; no point shall vary more than two feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed, the average plane of slopes shall conform to slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than six inches, measured at right angles to the slope.

## 301.4 SURPLUS MATERIAL

Unless otherwise shown on the plans, specified in the special provisions, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the Engineer, and shall upon request, of the Engineer, obtain the written consent of the owner of the property upon which he intends to dispose of such material.

If the quantity of surplus material is shown on the plans or specified in the special provisions, the quantity shown or specified is approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankment before disposing of any indicated surplus material inside or outside the right-of-way. Any shortage of material caused by premature disposal of surplus material by the Contractor, shall be replaced by him and no compensation will be allowed the Contractor for such replacement.

## 301.5 BORROW EXCAVATION

The Contractor shall be required to furnish additional suitable excavated material when directed by the Engineer. Any additional excavated material to be furnished by the Contractor shall be approved by the Engineer as to suitability prior to hauling the material to the project.

The Engineer will compute the quantities of material excavated by a method which in his opinion is best suited to obtain an accurate determination.

Excavation in excess of the planned or authorized cross-section will not be paid for. The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation of authorized section at no additional cost to the City.

Material resulting from excavating ditches or channels may be used to construct roadway embankments, dikes, or for other purposes, or disposed of, as directed by the Engineer.

Care shall be exercised to prevent excavating below the grade for the bottom of the ditch and areas excavated below grade shall be filled with suitable material and compacted by the Contractor at no additional cost to the City.

# SECTION 302

# GENERAL INFORMATION FOR FILL CONSTRUCTION

## 302.1 DESCRIPTION

Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed; and compacting approved material within areas where unsuitable material has been removed; and placing and compacting material in holes, pits and other depressions.

## 302.2 PLACING

Rocks, broken concrete, or other solid material, which are larger than four inches (4") in greatest dimension shall not be placed in fill areas where piles are to be placed or driven.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built one-half width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of four feet (4') horizontally as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground.

Clods or hard lumps of earth of six inches (6") in greatest dimension shall be broken up before compacting the material in embankment, except as provided in the following paragraph:

When the fill material includes large rock material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the fill. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact fill. However, such material shall not be placed within two feet (2') of the finished grade of the fill.

## 302.3 COMPACTING

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exceptions.

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping excessive loads of suitable materials in a uniformly distributed layer of thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

Unless specified herein, or in the special provisions, the construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas over which fills are to be placed shall be cleared and scarified to a depth of six inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than ninety-five percent (95%).

The loose thickness of each layer of fill material before compacting shall not exceed eight inches (8"), except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following requirements to a uniform density of not less than ninety percent (90%), except that where a new or widened roadway and appurtenances are required, density of the upper two feet (2') and when the fill is within two feet (2') of the above shall be not less than ninety- five percent (95%).

When fill material contains by volume over twenty-five percent (25%) of rock larger than six inches (6") in greatest dimension the fill below a plane three feet (3') below finished grade may be constructed in layers of a loose thickness before compaction not exceeding the maximum size of rock in the material, but not exceeding three feet (3') in thickness.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken Portland Cement concrete and bituminous-type pavement obtained from the project excavations will be permitted in the fill, upon approval of the Engineer, with the following limitation:

a) The maximum dimension of any piece used shall be six inches (6").
b) Pieces larger than four inches (4") shall not be placed within twelve inches (12") of any structure.
c) Pieces larger than two and one-half inches (2-1/2") shall not be placed within twelve inches (12") of the subgrade for paving.
d) Nesting of pieces will not be permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least two percent (2%) but no more than five percent (5%).

### 302.4 TESTS

Unless otherwise provided in the Plans or special provisions the fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T-99, Method A, and T- 191 or ASTM D-2922 and D-3017.

## 302.5 LOOSE FILL

When indicated on the Plans, fill in the right-of-way behind the curb and above the subgrade line. Utility easements shall be built up with loose fill.

Loose fill need not be placed in lifts and shall not be compacted. Loose fill material shall not have any rocks or debris over one and one-half inches (1-1/2") in size. The top six inches (6") of material shall be soil which is suitable for growth of vegetation.

# SECTION 303

# EARTHWORK FOR OPEN CHANNELS

## 303.1 DESCRIPTION

Earthwork for open channels shall consist of clearing, stripping, excavating, filling, grading, and disposing of excavated and removed material.

## 303.2 EXCAVATION OF CHANNELS

Excavation for channels shall be unclassified and shall include removal of all materials encountered during the construction of the work.

## 303.3 COMPACTED FILL FOR CHANNELS

When compacted fill is specified for channels, such fill shall conform to the applicable requirements as specified for compacted fill for pavement subgrade except for the density requirement.

When compaction is required, each lift of fill shall be uniformly compacted by a sheepsfoot roller until the tamping feet of the roller will walk out of the material and ride the top portion of the lift. Sheepsfoot rollers shall weigh such that the load on each tamper foot shall be not less than 200 pounds per square inch of cross-sectional area. The load per tamper foot will be determined by dividing the loaded weight of the roller by the number of tamper feet in one row parallel to the axis of the roller. When the fill is compacted by equipment other than a sheepsfoot roller, the material shall be compacted to a density equal to or greater than ninety percent (90%) of Standard Density.

## 303.4 POND LINERS

**General:**
Clay liners shall be placed in accordance with the following requirements as specified by the Engineer to control seepage and erosion.

**Required Physical Properties of Clay:**
Clays used as pond liners shall meet the following required physical properties:

| Property | Test Method | Test Value |
|---|---|---|
| Min. percent passing #200 sieve | ASTM D1140 | 80 |
| Min. liquid limit | ASTM D4318 | 40 |
| Min. plasticity index | ASTM D4318 | 25 |

**Slope Requirements:**
Side slopes above the maximum pool elevation shall not have slopes exceeding 4 to 1 except in special areas designated by the Engineer. Side slopes below the water line shall not have slopes exceeding 3 to 1.

**Liner Density Requirements:**
All areas of the clay liner shall be compacted to within 5 percent of optimum moisture content and have a density of 95 percent of the Standard Proctor.

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# SECTION 304

# RIPRAP CONSTRUCTION

## 304.1 DESCRIPTION

This specification controls the furnishing and installation of Stone Riprap to control erosion at drainage structures, storm sewer outlets and other areas requiring erosion protection. Riprap shall be installed to the lines, grades, and dimensions indicated on the plans.

## 304.2 GENERAL

Broken concrete may be used in lieu of stone, when specified, provided it meets the quality and size requirements. All exposed steel reinforcement must be cut off flush to the surface of the concrete. Large flat pieces of broken concrete and long sections of curb and gutter are not acceptable. Dimensions of individual pieces shall be compatible with lift thickness to be constructed.

## 304.3 MATERIALS

**Quality Requirements:**
Stone riprap furnished to control erosion at drainage structures, storm sewer outfalls and other areas requiring erosion protection shall meet one of the following material quality requirements:

**a) City of Wichita Specifications**

Material is to consist of individual fragments of stone which are dense, sound, resistant to abrasion and free of cracks, seams, or other defects which would increase the disintegration from water and frost actions. Material is to meet the following requirements:

1. Minimum saturated and surface dry specific gravity of 2.30.
2. Maximum absorption of 3.5 percent.
3. Loss not to exceed 18 percent as tested for soundness by the magnesium sulfate method.
4. Loss not to exceed 40 percent as tested for wear by the Los Angeles Abrasion Test.
5. Stone for riprap shall be free of earth, soapstone, shale and other easily disintegrated material that would decrease the durability of the material after placement.

All test methods shall be current ASTM methods.

**b) Department of the Army, Corps of Engineers Specifications**

**1. Weight and Absorption:** The minimum weight per solid cubic foot calculated from the bulk specific gravity (saturated surface-dry) of the sample determined, in accordance with the procedure in ASTM C-127, shall be 140 pounds. The maximum absorption shall be six percent (6%). Test samples shall be one and one-half inches (1-1/2") to two and one-half inches (2-1/2") in size.

2. **Soundness (Freezing and Thawing Test):** The loss of weight of stone after 20 cycles of freezing and thawing with test specimen immersed in water shall be less than 15 percent. Each cycle shall consist of 16 hours freezing at a temperature of 5 degrees F., and 8 hours at a temperature of 100 degrees F. The test specimens shall be prepared in accordance with the requirements of CRD-C 144.

3. **Soundness (Magnesium Sulfate Test):** The Loss of weight of stone after testing with 5 cycles of magnesium sulfate shall not exceed 18 percent. The tests shall be in accordance with the procedures designated in CRD-C 137 and ASTM C-88. The test shall be performed on 1-1/2 to 2-1/2 inch size aggregate.

4. **Resistance to Degradation:** Stone shall be subjected to the Los Angeles Abrasion Test (ASTM C-131) and shall show a loss in weight of not more than forty-five percent (45%) after 500 revolutions.

**c) Kansas Department of Transportation Specifications**

1. Specific Gravity (sat. & surf. dry), minimum by KT-6, Porc.....2.30
2. Soundness, minimum..... .....0.85
3. Wear, maximum ..... .... 45%
4. Deleterious Substances: Stone for riprap shall be free from earth, soapstone, shale, shalelike or other easily disintegrated material that will tend to decrease the durability of the material after placement.

**Gradation Requirements:**

**a) Floodway Heavy Stone Riprap:** Heavy stone riprap for erosion protection in the Floodway shall be constructed 24 inches in thickness. Stone used in heavy stone riprap shall meet the above specified quality requirements and the following size requirements:

| Weight of Individual Pieces | Minimum Percent Larger Than |
|---|---|
| 1,000 lbs. | 0% |
| 500 lbs. | 50% |
| 75 lbs. | 90% |

Broken concrete may be used as a fill material below the heavy stone riprap in the Floodway when approved by the Engineer. Broken concrete shall not be visible in the finished surface of the riprap.

**b) Heavy Stone Riprap:** Heavy stone riprap shall be constructed twenty-four inches (24") in thickness and shall be placed on a stone filter course backing having a thickness of nine inches (9). Stone used in heavy stone riprap shall meet the above-specified quality requirements and the following size requirements:

| Weight of Individual Pieces | Minimum Percent Larger Than |
|---|---|
| 1,000 lbs. | 0% |
| 500 lbs. | 50% |
| 75 lbs. | 90% |

Filter course backing for heavy stone riprap shall be produced from stone meeting the quality requirements of stone for riprap and shall have the following size requirements:

| Sieve Size | Percent Retained |
|---|---|
| 6" | 0% |
| 5" | 5-25% |
| 2" | 40-60% |
| 3/8" | 75-95% |

**c) Light Stone Riprap:** Light stone riprap shall be constructed eighteen inches (18") in thickness and shall be placed on a stone filter course backing having a thickness of six inches (6"). Stone used in light stone riprap shall meet the same quality requirements specified for heavy stone riprap and the following size requirements.

| Weight of Individual Pieces | Minimum Percent Larger Than |
|---|---|
| 500 lbs. | 0% |
| 250 lbs. | 50% |
| 125 lbs. | 70% |
| 10 lbs. | 90% |

Filter course backing for light stone riprap shall be produced from stone meeting the quality requirements of stone for riprap and shall have the following size requirements:

| Sieve Size | Percent Retained |
|---|---|
| 4" | 0-5% |
| 2" | 10-40% |
| 2" | 25-60% |
| 3/8" | 55-85% |
| #4 | 70-95% |

### 304.4 INSTALLATION OF STONE RIPRAP

Stone riprap shall be placed on a prepared bedding layer so as to produce a reasonably well-graded mass with a minimum practicable percentage of void. Stone riprap shall be placed to its full course thickness in one operation without displacing the bedding. Placing stone riprap by dumping into chutes or any other method likely to cause segregation will not be permitted. Placement of stone on the slope and in toe trenches shall be accomplished by controlled dumping directly in place.

Bulldozing of stone from the upper banks will not be permitted. Use of a drag line or similar equipment operated from the top of the bank to pull stone into position on the upper slope will be permitted. Stone riprap may be placed below water, providing it is placed by skip or another approved method which will prevent segregation. Larger stones should be well distributed and the entire mass of stones in their final position should be stable and free of pockets of small stones and clusters of larger ones; rearrangement of individual pieces by hand may be required to obtain the results described above. A tolerance of plus three inches (3") from the lines and grades shown on the plans will be allowed in the finished riprap surface, except that the extreme tolerance should not be continuous over an area greater than 100 square feet. Hand placing of riprap stones shall be necessary to produce reasonably true surfaces and close fit of stones. The larger spaces between the stones shall be fitted with spalls of suitable size, rammed thoroughly in place. The spaces between stones shall be filled with smaller rock, carefully hand placed in such a manner to obtain a tight surface.

Toewalls shall be installed along all unprotected edges of stone riprap construction. Such toewalls shall be constructed using the same size stone specified for the riprap with the toewall thickness being the same thickness as specified for the riprap without the filter course backing. The toewalls shall extend a minimum distance of 2' below the bottom of the filter course backing material and they shall be constructed perpendicular to the top surface of the riprap construction. Toewall construction shall be grouted in place for the full depth from the bottom of the toewall to the top surface of the riprap for the full thickness of the toewall.

When specified, all riprap placed within the limits of a dimension of 10' from pipe ends, pipe end sections and headwall structures, as measured from the outside edges of such pipe ends or structures, shall be grouted in place. Other areas shall be grouted when indicated by the plans. When grouted stone riprap is required, the spaces between the riprap stones shall be filled with grout consisting of one part Portland Type I/II cement, three parts of fine aggregate and sufficient water to form a plastic mix. The grout mixture shall be poured and broomed into the voids around the rock until all such voids are completely filled. Grouted stone riprap will be cured in the same manner as specified in the standard specifications for concrete pavement.

## 304.5 PRE-MIXED DRY PACKAGED CONCRETE RIPRAP BAGS

**General:**
When approved by the Engineer, the Contractor shall have the option of using pre-mixed dry packaged concrete riprap bags as an alternate to stone riprap construction.

**Material:**
Riprap bags shall be polyester laminated, scrim reinforced, perforated and embossed and shall weigh 86 to 88 pounds each when filled with dry concrete mix. The overall dimensions of the filled bags shall closely approximate 20"x13"x4-3/4". Paper bags shall be as manufactured by Georgia-Pacific or an approved equal. Bags shall be filled with a dry pre-mixed concrete mixture containing one part cement to three parts fine aggregate by weight. Cement and fine aggregate shall conform with the requirements specified for concrete pavement. No printing shall appear on the bag exterior.

**Installation:**
One layer of riprap bags placed on the specified nine inch (9") stone filter course backing shall be permitted as an alternate to heavy stone riprap. One layer of riprap bags placed on the specified six inch (6") stone filter course backing shall be permitted as an alternate to light stone riprap.

The packaged dry mixed concrete bags shall be placed on the stone filter course backing with a running bond pattern such that the ends of the bags in one row line up with the centerline of the bags placed in adjacent rows. The bags, as they are placed, shall be shoved tightly against bags already placed such that there will not be any voids between the bags after placement. The rectangular-shaped bags shall be placed with the longest dimension parallel with the slope contours and with the largest flat surface area placed on the stone filter course backing. Toewalls shall be installed along all unprotected edges of the riprap bag erosion protection. The toewalls shall be formed by placing riprap bags in a running bond pattern with the longest dimension parallel with the centerline of the toewall from the top of the stone filter course backing material to a depth 2' below the bottom on the stone filter course backing material. Such toewalls shall be approximately thirteen inches (13") thick and constructed perpendicular to the top surface of the erosion protection. The completed riprap bag erosion protection shall be sprayed with water such that each bag is thoroughly saturated with sufficient water to hydrate the cement in the concrete mix inside the bags.

# SECTION 305

# GABIONS

## 305.1 DESCRIPTION

This work shall consist of furnishing, assembling and filling woven wire mesh baskets with rock to form gabions and/or mattresses as specified in the contract in conformity with the dimensions, lines and grades shown on the plans, or established by the Engineer.

## 305.2 MATERIALS

**a)** **Wire Mesh.** All baskets shall be made from galvanized steel wire, Class 3, Finish 5, Soft, in accordance with ASTM A641-92. The wire tensile strength shall be in accordance with ASTM A641-92 (Soft) and the zinc coating shall be tested in accordance with ASTM A90- 81.

**b)** **Galvanized Gabion Mesh, Type 8x10.** Wire diameters for galvanized wire are measured after galvanizing. The mesh wire diameter shall be 3.05 mm (0.120 inches). The selvedge wire diameter shall be 3.9 mm (0.1535 inches). The mesh opening shall be a nominal 8x10 cm (3.25 x 4.5 inches).

**c)** **Lacing Wire and Internal Connecting Wire.** The diameter for lacing and internal connecting wire for galvanized baskets shall be 2.2 mm (0.0866 inches) measured after galvanizing.

**d)** **Fasteners.** Ring wire fasteners may be used in lieu of lacing wire for basket assembly and construction. For galvanized baskets, rings shall be formed from 3.05 mm (0.120 inch) diameter galvanized wire, measured after galvanizing, and have high tensile strength. The galvanizing shall conform to ASTM A641-92, Class 3 coating, tested in accordance with ASTM A90-81. Fasteners shall also be in accordance with ASTM A764, Class II, Type III. For PVC coated baskets, rings shall be formed from 3.05 mm (0.120 inch) diameter stainless steel wire having high tensile strength and shall conform to ASTM A313, Type 302, Class 1. Load tests shall conform to ASTM A370. Tensile strengths shall be determined per ASTM E8/MTP 2004. The spacing of the fasteners during all phases of assembly and construction shall not exceed approximately 15 cm (6 inches).

**e)** **Fabrication.** All baskets shall be made from non-raveling, double twisted, woven wire mesh. The mesh will have the ability to resist pulling apart at the twists or connections forming the mesh when a single wire in a mesh section is cut. They shall be fabricated so that the sides, ends, lids, and diaphragms can be assembled at the construction site into rectangular baskets of the required size. Where the length of the basket exceeds 1.5 times its horizontal width, it shall be equally divided by diaphragms, made of the same type mesh as the body, into cells in which the length does not exceed the horizontal width. The diaphragms shall be secured in position on the base so that no additional tying is necessary at this juncture.

**f)** **Gabions, Type 8x10 Mesh.** Gabion baskets shall be of single unit construction. The base, lid, ends and sides shall either be woven into a single unit or have one edge of the above components securely connected to the base section of the basket. All perimeter edges of the mesh forming the baskets, including end panels and tops of diaphragms, shall be selvedged with selvedge wire. For sound structural integrity, the gabion mesh wires shall be wrapped around the selvedge wire with a number of turns necessary to interconnect each of them with the adjacent mesh wire.

**g)** **Elongation.** Elongation tests shall be made, before fabrication of the baskets, on a wire sample 12 inches long. Elongation shall not be less than 12% in accordance with the requirements of ASTM A370-92.

**h)** **Strength.** The wire mesh shall not rupture when subjected to a load of 6,000 pounds for gabions, type 8x10 mesh, when applied as follows:

1. Clamp a section six feet (6') long, not less than three feet (3') wide, including the selvedge binding, for three feet (3') along the width, or in the middle for widths greater than three feet (3'), with the excess falling free on each side.
2. Apply tension to elongate the section 10%.
3. Apply the load, 6,000 or 4,000 pounds as stated above, to one square foot located approximately in the center of the sample between the clamps. The direction of the load should be perpendicular to the elongation tensions force direction and be applied with a circular ram head with the edges beveled or rounded to prevent cutting the wires.

**i)** **Gabion Rock.** The rock for gabions shall be hard, sound, durable and free from cracks and other structural defects that would cause it to deteriorate. It shall not contain any soapstone, shale or other material that easily disintegrates. Gabion rock shall not have an absorption rate greater than 4% and shall have a soundness ratio of not less than 0.80 after 25 cycles of freeze and thaw tests. The rock shall have a maximum dimension of eight inches (8") and a minimum dimension of five inches (5"). The majority of the stone shall be in the five-to-six inch range and cubical or rounded in shape. A tolerance of five percent (5%) shall be allowed on the upper and lower dimensions of the rock.

### 305.3 CONSTRUCTION REQUIREMENTS

**Assembling:**

Gabions and revet mattresses are supplied folded flat, or in rolls, and packed in bundles. Single units shall be removed from the bundle, unfolded on a hard flat surface, and have all kinks and bends worked out before assembly. The unit shall then be assembled individually by erecting the sides, ends and diaphragm(s) ensuring that all creases are in the correct position and the tops of all sides are satisfactorily leveled. For gabions, the four corners of the unit shall be connected first, followed by the edge wires of internal diaphragm(s) to the sides. For revet mattresses, the four corners of the unit shall be connected first, after overlapping the mesh at the corners, followed by the edges of internal diaphragms to the sides. All the mesh at connections should be accomplished using lacing wire or fasteners as described in **Subsection 305.2.** The recommended procedure to apply lacing wire consists of first cutting a sufficient length of lacing wire, approximately 135 to 150 cm (4.5 to 5 feet) long. Then secure one end of the wire by looping and twisting, proceed to lace with alternating single and double loops every other mesh opening (approximately every 15 cm or 6 inches) and securely fasten the other end of the lacing wire. The installation of the fasteners specified in **"Fasteners"** shall be done in accordance with the manufacturer's recommendations except that the spacing of the fasteners shall not exceed approximately 15 cm (six inches).

**Installation:**

After initial assembly, the baskets are carried to the work area and placed in their final location. For structural integrity, the adjoining empty baskets must be securely joined together using the same connecting procedure(s) described in **"Assembling"** along the vertical edges and the top edge of their contact surfaces in order to obtain a monolithic structure. Whenever a structure requires more than one tier, the upper empty baskets shall also be connected to the top of the lower tier along the front and back edges of the contact surface using the same connecting procedure(s) described in **"Assembling."**

**Filling:**
Gabions shall be filled with rock as specified in **Subsection 305.2 "Gabion Rock".** Baskets may be filled by almost any type of earth handling equipment such as: backhoes, trackhoes, gradalls, cranes, end loaders, etc. Some manual stone adjustment during the filling operation is required to minimize voids. When specified by the Engineer, the exposed faces of vertical structures shall be carefully stacked by hand to give a neat, compact appearance. The cells in any row shall be filled in stages so that local deformation may be avoided, that is, at no time shall any cell be filled to a depth exceeding one foot (1') more than the adjoining cell. It is also recommended to slightly overfill the baskets by approximately two inches (2") toward the center of each cell to allow for settlement. It is good practice to backfill gabion walls immediately following the gabion filling operation of each tier, if so permitted by site conditions. Well-packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

**Internal Connecting Wires:**
Internal connecting wires may be needed when a structure requires various tiers to be stacked on top of each other.

**36" (3') High Gabions:**
Thirty-six inch (36") (3') high gabions shall be filled in three layers, one foot at a time. After the placement of each layer, that is, at one foot (1') high and two feet (2') high, connecting wires shall be placed according to the manufacturers' recommendations to connect the exposed face of a cell to the opposite side of the cell. An exposed face is any side of a cell that will be exposed or unsupported after the structure is completed.

**18" (1.5') High Gabions:**
Eighteen inch (18") (1.5') high gabions do not require connecting wires unless the baskets are used to build vertical structures. In some cases, these units shall be filled in two layers, nine inches at a time. After the placement of each layer, connecting wires shall be placed according to the manufacturers' recommendations to connect the exposed face of a cell to the opposite side of the cell. An exposed face is any side of a cell that will be exposed or unsupported after the structure is completed.

**Lid Closing:**
Once the baskets are completely full, the lids shall be stretched tight over the rock using lid closing tools until the lid meets the perimeter edges of the basket. The lid shall then be tightly laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described in **"Assembling."** Upon completion, the structure shall be checked and all ends of wires shall be folded into the structure. Well-packed filling without undue bulging, and secure lacing and/or fastening, is essential in all structures.

**Cutting and Folding Mesh:**
Where shown on the drawings or otherwise directed by the Engineer, the basket mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent gabion face. The cut edges of the mesh shall be securely laced together with lacing wire or fasteners in the manner described in **"Assembling."** Any reshaped gabions shall be assembled, installed, filled and closed as specified in the previous sections.

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# SECTION 306

# FLOWABLE FILL

## 306.1 DESCRIPTION

This work shall consist of an excavatable flowable mortar fill material in sewer, water and utility trenches under the pavement or at other locations as shown on the plans or as specified. The work shall be done in accordance with this specification.

## 306.2 MATERIALS

The mix design for flowable fill mortar shall be approved by the Engineer and shall meet the following requirements:

a) Cement shall be Type I.
b) Fly Ash shall meet requirements of ASTM C618, Class C, and shall come from a source approved by the engineer.
c) Fine Aggregate for flowable mortar shall be natural sand consisting of mineral aggregate particles. The gradation of this material shall be as follows:

| Sieve Size | % Passing |
|---|---|
| 3/4 | 100 |
| 200 | 0-10 |

d) Physical Properties. The required physical properties for flowable mortar is as follows:

1. Self-leveling

2. 15% Minimum air content

3. Unit weight less than 120 lbs/cf

It is intended that the flowable fill produce a minimum 75 psi and a maximum 250 psi compressive strength at 28 days. Set accelerator may be required when flowable fill is placed at temperatures below $85^{o}$F to obtain the necessary support required for traffic and subsequent work at the end of the specified 72-hour period.

## 306.3 PROPORTIONING AND MIXING EQUIPMENT

Sufficient mixing capacity or mixers shall be provided to permit the intended pour to be placed without interruption.

## 306.4 PLACEMENT OF FLOWABLE FILL

The flowable fill shall be placed in an area defined as the length of the trench line under the pavement plus two feet (2') beyond either side of the pavement by the trench width. The fill shall be brought up uniformly to an elevation 12 inches above the top of the pipe or two feet below the bottom of proposed pavement, whichever is higher. Placement of fill shall then cease and the fill protected from traffic for a period of 72 hours.

## 306.5 LIMITATION OF OPERATIONS

a) Flowable Fill shall not be placed on frozen ground.
b) Flowable Fill batching, mixing, and placing may be started, if weather conditions are favorable. The cold weather operation shall conform to the same conditions as specified in the City Standard Specifications for Concrete Pavement.
c) Each filling stage shall be as continuous an operation as is practicable.

## 306.6 QUANTITY OF FLOWABLE FILL REQUIRED

The Contractor shall provide and place a sufficient volumetric quantity of flowable fill material to meet the requirement of this specification regardless of trench depth and/or pipe sizes, unless otherwise indicated by the project plans or special provisions.